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EDITORIAL.

TAPPING EXPERIMENTS WITH BUD-GRAFTED RUBBER.

THE widespread interest shown in bud-grafting makes Dr. Vischer's article in the November number of the Archief v.d. Rubber-cultuur on "Tapping experements with bud-grafted rubber" of uncommon importance. So many diverse rumours have been in circulation that a clear and candid presentation of the facts ascertained up to the present is extremely welcome. Grafting was performed from October 1917—January 1918, bud-wood being taken from five mother trees, four of which were abnormally high yielders. Results are given for average daily yields over 7 months tapping from plots of 84 to 123 trees.

MOTHER TREES:

The mother trees were planted in 1907–8 and gave the following daily average in grams dry rubber (4 grs. per day = approx. 3.1 lbs. per year of 350 tapping days).

	1916.	1917.	1918.	1919.	1920.	1921.
P.W. 34 ...	26.0	37.3	45.3	43.7	25	(brown bast)
„ 225 ...	43.0	48.6	56.2	65.0	37	(„ „)
„ 2 ...	37	45	49	59	27 23	(„ „)
„ 217 ...	47	47	b.b.			
„ X	Unknown ?					

LATEX RINGS WERE.

Height at which measured.	1919. 1.60 M.	1919. 5 M.	1922. 1.60 M.	1922. 5 M.
P.W. 34 ...	52	27	53	32
„ 2 ...	38		50	28
„ 225 ...	28	24	45	24
„ 217 ...	45	42	65	48
„ X ...	?	?		

Dr. Vischer points out the surprising fact that all four known mother trees developed brown bast; it is impossible to decide whether this denotes susceptibility or was due to weakening of the tree brought about by removal of branches for use as bud-wood. He further notes that P.W. 34 with the highest number of latex rings was the poorest yielder, while P.W. 225 was exactly the reverse.

Tables are given showing a high correlation between circumference and numbers of latex-vessel rings—these are summarised as follows:—

OFFSPRING:

P.W. 34	Av. circumference.	37.62 cms. $\pm$ 9.0.	Rings 8.76 $\pm$ 4.8
		Coefficient of correlation	0.781 $\pm$ .008
P.W. 2	„	34.82 $\pm$ 8.9	7.77 $\pm$ 2.88
		„ „ „	0.682 $\pm$ .069
P.W. 225	„	38.94 $\pm$ 10.5	$\pm$ 2.0
		„ „ „	6.74 0.3 $\pm$ .056
P.W. 217 Group (i)		„ „ „	0.88 $\pm$ .012
„ „ (ii)		„ „ „	0.655 $\pm$ .13

These correlation coefficients are all high compared with that found by La Rue for plants grown from seed which was 0.162. Dr. Vischer considers from these figures that two definite types—many and few latex rings—may be separated, and that the relationship of rings to circumference is a congenital (inner) character which is passed on from the mother tree to the scions.

Table V gives average production per tree per day in grams *wet* creped latex rubber, for three of the bud-grafted plots, tapped on $\frac{1}{3}$ daily.

	P.W. 34	P.W. 225	P.W. 2
May	9.1	7.0	6.6
June	8.8	5.0	5.5
July	9.1 (7.5)	4.0 (2.4)	5.1 (4.4)
August	7.0	1.7	3.5
September	6.1	3.0	5.0
October 1—4	9.6	3.6	5.0
October 11—31	7.0	4.5	4.4

The figures in brackets for July are weights of *dry* rubber. On October 5th all were put on a new tapping cut at 1M. high on $\frac{1}{4}$—no records are therefore given for October 5—10th.

Table VI gives individual production figures for *dry* rubber during July—

P.W. 34—	93 trees	Av. yield = 7.54 gr.	Stand. deviation ± 2.5
2	84	4.4	± 1.8
225	123	2.4	± 1.2
217(i)	96	3.4	± 1.7
(ii)	37	6.4	± 1.8

It is pointed out that the observed variation within each group in much smaller than that in seed plants—a number of which at 6 years had a daily average of 8.3 gr. with a standard deviation of ± 5.4.

Table VII gives yields in grams of *dry* rubber per day of seed stock planted March 1916. 36 trees tapped on $\frac{1}{2}$.

1920.		1921.		1922.	
April	1.9	Jan.-July not tapped.		January	5.3
May	2.5	August	5.4	February	5.2
June	2.6	September	4.7	March	4.8
July	2.8	October	4.5	April	6.2
August	2.6	November	6.0	May	6.7
September	3.1	December	5.0	June	6.9
October	3.5			July	6.5
				August	5.7

Dr. Vischer is careful to point out that no final conclusions can be drawn from the figures given. It is impossible to predict the effect of future tapping from analogies with seed stock and comparison with seed stock plants of exactly similar age was impossible. The fairest comparison is probably with the yields of August-December 1921 given in Table VII.

Further the months on which the bud-grafts were tapped included the wintering months. Wintering is very much more uniform in the case of bud-grafts of the same parentage, than in a mixed seedling population.

Dr. Visecher points out the necessity of vigorously continuing the selection work in Java.

These most interesting records contain but cold comfort for those who consider yields of 1—2 tons per acre to be within their grasp in say — five years time, and give point to the warnings given both in the Handbook of Malayan Agriculture[1] and the Malayan Agricultural Journal[2], that bud grafting is still in the experimental stage. It is a necessary and invaluable experiment, but — an experiment.

(1) Malayan Agriculture, Handbook compiled by the Department of Agriculture, F.M.S. & S.S. 1922. Pages 54 & 64.

(2) M.A.J. Vol. X, No. 4, April, 1922, p. 112.

The outstanding facts are :—

1. All the carefully selected high yielding mother trees developed brown bast. While the removal of branches may have brought about the attacks, our statement that "high yielders are to be regarded with suspicion" appears to hold good outside Malaya.

2. Although all the grafts from a single mother tree show a marked similarity in yield to each other, they *do not necessarily resemble their parent*, and may in fact be all very poor yielders.

3. So far as comparison can be made, only one of four abnormally high yielders gave bud-grafts which had definitely a higher yield than plants from seedling stock (which does not appear to have been from selected seed), while one gave about half the yield.

It is useless to labour these points — further work is obviously required before budgrafting can be regarded as a success. As it stands at present an estate with large areas planted from a small number of selected mother trees might find—

1. All susceptible to brown bast.

2. Considerable numbers definitely and *uniformly* below the average of seed stock plants of similar ages.

It is of course possible that future work will bring to light a quick method of finding mother trees which are immune to brown bast and which "bud true," but the time is not yet. At present one generation must be allowed to mature and be tapped to settle the second point.

In the end it may be found that the average plant, like the average man, has the finest staying power, and it is staying power which is wanted on a plantation.

BUD SELECTION IN "HEVEA."

By H. W. Jack.

THE budding of "Hevea" seedlings is now practiced on many estates and while, theoretically, it is fairly safe to assume that some slight improvement in yield of latex will result, there is a decided tendency, in the writer's opinion, to expect far too great an improvement so that these few notes may serve a useful purpose in warning planters against too sanguine expectations. While there is no intention of discouraging experiments in the various methods of budding, these notes are intended to indicate some reasons why public anticipations of fabulous yields of rubber per acre are likely to prove disappointing. In the selection of trees for use as budwood, assuming that only robust, healthy trees of good yielding ability are used, the resulting plantation of buddings should undoubtedly be some improvement over the plantation which contained the parent bud stock, provided that environmental conditions in the daughter plantation are similar to those in the parental area. This improvement is simply due to the elimination of obviously poor and defective individuals in the process of selecting trees and is likely to be restricted to agricultural characters, the yield of latex showing no proportionate increase, for it is widely known that there is no relationship between yield of rubber and the appearance of the tree.

Let us consider the methods adopted for selecting parent trees. The first essential is the health of the tree as determined by thorough external examination. Apparent healthiness does not, however indicate immunity to disease because absence of disease is often merely due to the absence of sources of infection and a change of environment may synchronise with the proximity of disease resulting in infection to the detriment of the offspring of the selected healthy tree.

Secondly, trees are selected by counts of the number of latex rings contained in the barks on the assumption that bark having many latex rings will yield a proportionate amount of latex. This method is not practical as far as the average planter is concerned, and there is as yet no adequate proof that buds from trees selected by this method will produce trees showing an equal or even similar number of latex rings. Moreover, the coefficient of correlation between the number of latex rings in the bark of a tree and its actual yielding ability, as calculated from several series of figures, has been found to vary from near zero up to round about 0.5 only. These extremes of coefficient are of no significence—they merely indicate that, at the best, the chances of a correlation between the characters in question, are even.

In the third place, trees are selected by actual yield comparisons by taking periodic records of yield either by volume of latex or weight of dry rubber, over a variable length of time, usually not less than a

complete annual cycle. This method is certainly the best but has its imperfections, for invariably little or no account is taken of the environment of the tree, its inherent constitution or the tapping error of the coolie.

Under the term environment, probably the most vital considerations are those of soil texture and water supply, both factors of admittedly great importance to the economy of the tree, yet budwood from selected parents trees is often railed hundreds of miles to different parts of the country or even to another country and the resulting plantation of buddings is expected to show similar characters and to produce latex at the same rate as the parent tree. With regard to the inherent constitution of the selected parent tree usually nothing whatever is known and no recognition is taken of the problems of variation to which buddings may be liable, for, as far as "hevea" is concerned, little is yet known as to whether propagation by budding really does provide a progeny having the same characteristics as the parent, a doubt which is emphasied by the fact that most buddings are grown on a foreign root stock. Shamel, a noted American authority on bud variations divided them into two classes (i) those which are not inherited, and (ii) those which are inherited, and in the first class he includes all variations which are due to environmental influences.

Now, in selecting a parent tree by comparison of actual yield records it is impossible to form any definite opinion as to whether its yielding ability is an inherent character of the tree or whether it is merely a fluctuating variation dependent on environmental influences. If the tree comes under the latter category, then its use as budwood for the establishment of a budded plantation under conditions even slightly dissimilar would be of little avail and experience shows that chemical and more particularly physical conditions vary considerably even over very short distances on the same area of land.

Again, under this method of selection the coolie error of tapping, which, as is well known, is a very material one, is usually neglected. The number of rings of latex vessels in the bark increases rapidly in each successive millimetre working inwards to the cambium and this accounts largely for the large variation in yield of latex from the same tree if tapped by different tappers whose skill is guaged by the depth of bark which they can excise without causing damage to the cambial layer.

Although vegetative propagation has been extensively practiced with many plant forms in the last few decades there appear to be no results with any crop really comparable to "Hevea." Quinine (*cinchona sp.*) is the nearest approach. Working with several species of this crop for nearly forty years, a crop increase has been effected by Dutch workers in Java by propagating vegetatively only those plants showing a high alkaloid content in the bark combined with good growth characters but little improvement of the best types originally introduced into that country has resulted.

If the results of vegetative propagation, as applied to fruit trees, are considered, it is found that though a high degree of crop improvement is attained yet the inherent characters of varieties show no such amelioration, in other words there is no improvement of the race. The Victoria plum, for instance, though it has been grown true to type by buddings for many years yet when propagated from seed immediatedly gives rise to innumerable different forms having characters varying widely from those of the parent plant. As another example of the failure of bud selection to achieve any improvement of the race, reference may be made to sugarcane. Countless attempts have been made in several countries to propagate vegetatively plants of a particular variety showing a specially high content of sugar but not a single attempt has yet been succesful. In contrast to this failure, beet plants when selected for high sugar production and propagated by seed, gave rise to progeny which showed similar high sugar contents, within the limits of fluctuating variation. Also experiments which have been made with "cacao" in Trinidad to compare the results of the propagation of good plants by seeds and by vegetative methods, show that plants grown from seed yield more heavily than budded or grafted plants derived from the same parent trees.

The vegetative propagation of notably good tea plants has also been tried for many years but all such efforts have long since been abandoned in favour of seed propagation.

With "Hevea" there is as yet no known morphological character which can be definitely correlated with yield of rubber and until some such character can be found all vegetative propagation is of the nature of an experiment of which the issue can only be determined by the lapse of time. Dutch research workers lead the way in the question of vegetative propagation of this plant but even in Java, no conclusive records are yet available to show that budded plants are superior to plants raised from seed, though there is some evidence that the process of eliminating obviously poor trees in the selection of parent plants has a beneficial effect on the progeny of the latter.

It is hoped that these notes may help planters to realise that, though the art of budding is now mastered, the practice of budding is still in the experimental stage and should therefore only be adopted on estates with due caution and with reserved anticipations of its results.

The study of methods of vegetative propagation of "Hevea" other than by budding might prove useful in the interval, while waiting for definite proof regarding the efficacy of budding.

A PRELIMINRAY ACCOUNT OF OBSERVATIONS ON THE FUNGI CAUSING "BROWN ROOT" DISEASE.

A. Sharples.

BUTLER[1] says under the heading of "*Brown Root disease* (*Hymenochaetae noxia Berk*)."

"This is one of the diseases formerly included under the general name "Stump Rot," since it ordinary arises, like the diseases caused by Rosellinia and Ustulina from the decaying stump of some jungle or shade tree, which has been cut down and left to rot in the soil in which the tea is growing. It is widely distributed in the tropics, occuring in Ceylon, the Malay Peninsula, Java, Sumatra, New Guinea, Samoa, and East and West Africa. It attacks a number of the most valuable tropical products and also jungle trees; rubber (Hevea, Manihot, Castilloa, Funtumia) coffee, cacao, camphor, breadfruit, Caravonica, cotton, coca, dadap (*Erythrina sp.*), *Grevillea robusta*, *Cinnamomum Cassia*, *Albizzia stipulata*, and *Brunfelsia americana*, being amongst its victims. It is the commonest root disease of rubber in Ceylon, and the only one known to attack cacao in that colony. In India, it has, so far, been noticed on tea, coffee, Hevea, Manihot, and Grevillea only, but will probably be found on other hosts."

Petch[2] describes the symptoms on rubber (*Hevea brasiliensis*) as follows:—"It was first recorded on *Hevea* in Ceylon and it is probably the commonest root disease of the Rubber tree in that country .....Brown Root disease spreads very slowly.....consequently it only infects the neighbouring trees when their roots are in contact with those of the diseased tree and the progress of the fungus is so slow that, as a rule, the first affected tree is dead before the neighbouring trees are attacked. In general, therefore, only one tree is killed at each centre of infection, unless the dead tree is left standing for a long period."

"When the dead tree is dug up the special characters of Brown Root disease are usually immediately obvious and as a rule, there can be no mistake in the diagnosis. The roots are encrusted with a mass of sand, earth and small stones to a thickness of three of four millimetres; this mass is fastened to the root by the mycelium of the fungus and consequently cannot be washed off. The mycelium consists of tawny brown threads which are collected here and there into small sheets or loose masses, either on the surface or embedded in the crust of soil and stones. The colour of the mycelium varies and one frequently finds brownish-white, or almost white masses intermingled with the tawny brown. In the early stages the predominating colour of the mycelium is brown, and this is usually the case, when the roots of a dead tree are examined. Hence the name Brown

1 Butler, E. J.---Fungi and disease in plants. 1918 p. 429.

2 Petch, T.---The diseases and pests of the Rubber tree. 1921 p. 41.

Root disease. But when the fungus has been established for a long time, and has grown older, it forms a black, brittle continuous covering over the brown masses of hyphae, and the diseased root then appears chiefly black. The brown mycelium is, however, immediately discernible if the black crust is cut."

"*In all cases, the encrusting mass of earth and stones, intermingled with brown threads serves to distinguish this disease.*"

"The diseased wood usually shows characteristic markings, though these may be of two entirely different types. In one case the wood is soft and friable, with a network of fine brown lines and even with a hand-lens it can be seen that these lines are composed of brown hyphae. Thin sheets of brown hyphae run through the decaying wood, and these appear as brown lines when the wood is cut. This is the more frequent appearance in the lateral roots. In the other case the wood of the root is comparatively hard, and traversed by rather broad, brown bands in which no hyphae are discernible. This may occur in the lateral roots, but is more usual at the base of the stem. There is some evidence that the appearance first described follows the second. In either case the wood in an advanced stage of decay may be honeycombed, the brown plates persisting after the tissue between them has almost completely decayed."

The above extracts were, in a general way, applicable to our knowledge of "Brown Root" disease on *Hevea brasiliensis* in Malaya. Up to 1920, no special attention was necessary, and this disease was comparatively scarce. In that year during the progress of thinning-out operations on a Malayan estate, cases of Brown Root disease on old trees were so numerous as to call for special attention.

In this preliminary article it is unnecessary to go into detail. The diagnosis in the above cases was Brown Root disease, the typical encrusting mass of earth and stones being prominent in all cases. On splitting the lateral roots, the wood was much harder than in healthy roots and split with prominent, usually transverse corrugations. Brown lines in the diseased tissue were not prominent, though occasionally present.

As a good supply of material was available, isolations were attempted and pure culturos obtained. The causative fungus had previous to 1917 been referred to *Hymenochaetae noxia* (Berk) but during 1917, Petch obtained numerous fructifications of *Fomes Lamoensis* (Murr) from Tea and Hevea plants killed by Brown Root disease. He says (loc. cit), "These show that the fungus is really a *Fomes* and that the brown patches hitherto observed, the supposed *Hymenochaetae* are merely abortive attempts to produce the *Fomes* sporophore." This statement without support by work on pure culture lines could not be considered conclusive, so attempts to study pure cultures were undertaken in order to gain positive evidence.

Pure cultures on rubber wood blocks were obtained from the diseased Hevea roots mentioned above. A check was made by

obtaining pure cultures of the fungus causing Brown Root disease on Camphor (*Cinnamomum camphora)* a large patch of which had been slowly dying out for years owing to Brown Root disease in the Experimental Gardens, Kuala Lumpur. The cultures were so distinct that it was scarcely possible they could be one and the same fungus. This immediately raised the possibility of many different fungi able, when attacking roots of different tropical crops, to produce similar symptoms, the latter being classed under the general heading of Brown Root disease.

This possibility was tested further by getting typical Brown Root disease specimens of Rubber roots sent from Ceylon. These were in good condition and successful cultures established. This again resulted in a fungus obviously different from the preceding two.

Details of distinguishing features in the cultures may be left for a further publication. In every feature they were easily distinguishable, yet they had one peculiarity in common, *the secretion of mucilage by the hyphae when in contact with water.* When grown on wood blocks in Roux tubes, the hyphae penetrate through the cotton wool pad separating the culture block from the water, aggregate on the surface and after a few weeks, a large mucilaginous mass is visible in the water, attached to the hyphae. There can be little doubt that this production of mucilage in contact with water is the explanation of the typical symptoms presented in Brown Root disease the secretion of mucilage causing the binding together of the encrusting mass of earth and stones.

There are then three different morphological fungi associated with Brown Root disease which physiologically, are comparable. The question now to be answered is, Whether it is not possible that the symptoms characterising Brown Root disease on its varied hosts are produced by just as many different fungi morphologically, but similar in a physiological sense in that they all possess hypha capable of secreting mucilage on contact with water? The evidence obtained during the investigation supports an affirmative reply.

The Camphor Brown Root fungus and the Ceylon Brown Root fungus are well separated by their cultural characteristics, though in their final stages they show characters considered typical of the genus *Hymenochaetae.* The Malayan Brown Root appears to be forming fructifications much resembling those of a typical *Corticium.*

A final detailed publication with illustrations will be issued in due course.

MOTHS FROM COCONUT SPIKES.

By G. H. Corbett.

IN continuation of the preliminary note on the "Lesser" Coconut Spike Moth published in The Malayan Agricultural Journal, Vol. X, No. 5, the four species of moths bred from coconut spikes have been identified by Mr. E. Meyrick as follows :—

Tirathaba sp. near *trichogramma*, Meyr. "Greater" Coconut spike moth.

Erecthias flavistriata, Wals.

Pyroderces ptilodelta, Meyr.

Batrachedra arenosella, Walk. "Lesser" Coconut Spike Moth.

The three former were obtained from opened spikes showing considerably decay.

Dr. Guy. A. K. Marshall, Director of the Imperial Bureau of Entomology, in his letter forwarding the above identifications stated in reply to an enquiry for information, that he was unable to ascertain that anything has been previously recorded with regard to the habits or life history of *Batrachedra arenosella*.

Mr. Bainbridge Fletcher in his "Life Histories of Indian Insects, Microlepidoptera" published in the Memoirs of the Department of Agriculture in India, Vol. (VI), Nos. 1—9 states "originally described from New Zealand, this widely distributed species is now known to occur also in Tasmania, Queensland, New South Wales, South Australia, and British Guiana. Within our limits it has been recorded from Maskeliya, Coorg, Bangalore, Calcutta, and the Khasi Hills. We have it from Pusa" and quotes from Pr. Linn, Soc. N.S.W. XXII, 302—303 (1897) "Larva amongst seeds of *Juncus*, joining them together with a slight web. Pupa very slender in a cocoon amongst the seeds."

Rao Sahib V. Ramachandra Rao in "A Preliminary list of Insect Pests of Mesopotamia" published in the Report of the Proceedings of the Fourth Entomological Meeting held at Pusa in 1921, referring to the Date palm states that "The most serious pest of the Date palm in Mesopotamia is the "Hashaf" Moth ; young fruits are bored into by a small caterpillar, whereby they turn red, dry up, and drop down ultimately. The loss according to Buxton may be as much as 50 per cent. Buxton refers to his pest as a Gelechiad but he did not rear the moth. Specimens of moths reared and brought here (Pusa) with me are pronounced by the Imperial Entomologist to belong to the Family Cosmopterygidae."*

* The Editor, Mr. Bainbridge Fletcher, of the above publication in a foot note on page 168 records. "Since identified as *Batrachedra amydraula*, Meyr"

It has yet to be decided if the damage caused by the caterpillars of *Batrachedra arenosella* to the male and female flowers of the coconut spikes before opening is so serious as *Batrachedra amydraula* on the young fruits of the Date palm, but the female flowers of coconut spikes examined show a greater percentage of direct injury.

DESICCATED SHREDDED COCONUT AND OTHER COCONUT PRODUCTS.

By B. J. Eaton.

AN enquiry has been received recently from the Malay States Information Agency regarding the production of desiccated coconut in Malaya, owing to the fact that several produce merchants have approached the Agency on the subject.

Desiccated shredded coconut is an article of export from Ceylon and there is no reason why this product, together with other preparations of fresh coconuts, should not be prepared locally for export.

In America the three principal products on the market are :

(1) Fresh grated coconut canned in its own milk or water ;

(2) Moist sweetened coconut without the milk in cans ;

(3) Dried shredded coconut prepared with sugar in cardboard packages.

Manufacture.—The manufacture of the first two of these products might be taken up by the pineapple canning factories in Malaya, since these firms already possess the necessary machinery for the manufacture of the tins or cans from imported tin-plate and also the necessary plant for sterilization.

The manufacture of dried shredded coconut might also be undertaken in similar factories since it would, in the writer's opinion, be necessary to export dried shredded coconut in tins rather than in cardboard packages. This product however could be exported in large tins, so that if necessary, smaller cardboard packages could be prepared by wholesale dealers in the importing countries.

In experiments carried out by the writer about three years ago, it was found that desiccated coconut, dried to a moisture content of about 5 per cent., rapidly absorbed moisture in this climate and became very rancid, so that this product requires to be stored locally and exported in sealed tins. It would probably not be desirable to add boric acid or other preservative, in the case of this product, which is used as a foodstuff or for confectionery purposes. The addition of sugar and/or salt would probably prevent the development of the rancidity.

The local pineapple canning factories have two seasons, during which the factories are fully occupied in the canning of pineapples. These seasons coincide with the two principal fruiting seasons of the pineapple. During the remaining months, work at these factories is slack and most of the labour is discharged, so that the canning of coconut products could probably be undertaken particularly during these months and the labour retained.

Further enquiries are being made in this connection with the object of endeavouring to start a local industry for the export of these products.

Preparation of Products.—In the preparation of the dried shredded product, the skin or testa of the copra would have to be removed first by hand or mechanical peeling and the "meat" shredded by machinery and dried in vacuum ovens or in hot air chambers. A mechanical drier, such as a hot chamber through which endless band conveyors, on which the shredded material is spread in thin layers, are passed, would be suitable. Such a drier is in operation on one estate in Malaya.

In the preparation of shredded coconut preserved in its own milk or water the material would be preferably heated to a temperature below the boiling point of water before being placed in the tins and then subjected to a higher temperature for a short time after sealing the tins.

Moist sweetened coconut could be canned by placing the meat in a sugar solution as in the case of pineapples, and sterilizing the product in the tins by heating.

PREPARATION OF DESICCATED SHREDDED COCONUT.

The following details of preparation of desiccated shredded coconut should be of value to prospective manufacturers:

Husking.—The husk is removed by bringing the nut down forcibly on a spike fixed upright in the ground. The spike pierces the nut which is given a twist by the coolie and removed. A coolie can husk 200 nuts per hour. This is the common method of husking practised in Malaya.

Removal of Shell.—In order to leave the kernel whole, the shell has to be removed carefully. The husked nut is taken to a small circular saw which is provided with a concave guard to fit an averaged sized nut. The saw projects beyond the guard an amount equal to somewhat less than the thickness of the shell, so that it is unable to penetrate the kernel. The shell is cut all round in quarters and about 220 nuts can be treated per hour. The nut is then broken by means of a spear hammer without damaging the kernel. A coolie can treat about 110 nuts per hour.

Removal of Skin or Testa.—The brown skin or testa is then removed by means of a shaped spoke shave and the kernel is pierced to allow the "milk" to escape. A coolie can roughly clean about 110 nuts per hour. Any particle of brown skin left after the preliminary treatment is removed by another coolie.

Cutting and Shredding.—The nut is then removed to a cutter or shredder depending on whether chips or shreds are required.

For the manufacture of chips a machine containing a disc revolving in a hopper is employed, to which knives are fitted on the side.

For the manufacture of desiccated shredded coconut the nuts are fed into a machine containing numerous small circular saws—say 20 of about 8 inches diameter—spaced about 3/8 inches apart. The hopper into which the nuts are fed has a horizontal reciprocating motion of about 1½ inches, which together with the ratio of speed of the saws makes longer or shorter shreds as required.

Drying or Desiccation.—The material is now ready for drying and this is carried out in a chamber with forced draught at a temperature of 160°—190°Fah. When dry the material is ready for packing.

Packing.—The product is usually packed like tea in lead-lined cases or lead packets.

Bye-Products.—Rejected nuts are used for the preparation of oil, as are also the parings and tailings from the factory.

Anderson Oil Expellers are used for first pressing, followed by hydraulic expressers for second pressing to obtain the maximum of oil. In the case of local companies manufacturing desiccated coconut products only, the waste material could probably be sold to local oil mills. The husk, not used for fibre manufacture, can be used as fuel for heating the driers. The shell can also be used as fuel for a similar purpose or converted into charcoal.

FACTORY AND MACHINERY REQUIRED FOR MANUFACTURE OF DESICCATED COCONUT.

The following details have been supplied by a firm which manufactures machinery for the preparation of desiccated coconuts :

	£	s.	d.
Grating Machine.—Improved coconut grating machine (output 10-15 cwt. per day) price ...	97	13	0
Drying Plant.—Chula drying machine ...	250	0	0
Sifting Machine.—Sifting machine ...	112	0	0

Remarks on Factory and Machinery.—A good light airy factory is required with a cement floor and a good supply of fresh water.

The nuts should be husked outside the factory to avoid contamination with fibre and dust. The shells can be removed outside the factory or at one end and the kernel peeled inside the factory.

A cement trough containing clean water is advisable, so that the kernels can be washed after peeling to remove more readily any particles of skin (testa) or dirt.

The grating machine designed by the firm mentioned is based on the description of the shredding method described above. The peeled kernel is placed in the hopper of the machine on an adjustable guide through which fine pitch revolving circular saws protrude, which grate the kernel clean.

The machine can be adjusted to give varying proportions of fine and coarse material. A hand machine is also made by this firm, but no price has been quoted.

Drying Plant.—The shredded material is spread on light steel trays with galvanised steel wire gauze bottoms which are placed on runners in the drying chamber.

The hot air is drawn over each row of trays by means of a fan provided. The shredded material should be spread in a thin layer on the trays and the finer grades can be dried in about ½ hour at 190° Fah., but a lower temperature (160°Fah.) is recommended and a drying period of about 1½ hours for each charge.

The dried material should be allowed to cool off before being sifted and packed. A drier capable of an output of 100 lbs. per hour is quoted at £176, while the larger machine quoted at £250 has an output of 200 lbs. per hour. The driers required 1 and 1½ H.P. respectively for running.

Sifting Machines.—The sifting machine, which consists of coarse and fine oscillating screens or sieves, separates the dried shredded product into three grades, the coarsest material being delivered at the top, while the medium and fine material passes through the coarse sieve and is separated by the second sieve below, which only passes the finest material. The machine only requires about ½ H.P. for operation.

The total power required therefore for a small factory for one grating, drying and sifting machine is about 5-6 H.P.

A small grinding machine and the sifting machine could be worked easily by hand.

Market Prices.—Recent quotations in London for desiccated coconut are as follows :—(April 1922).

Fine	40/	per cwt.
Medium	40/6	„ „
Coarse	43/	„ „
Chips and threads	60/	„ „

The fine, medium and coarse grades are the three grades obtained on the sifting machine previously described. No recent information is available as to the prices of the other tinned products, but in 1920, in America, tins containing 4 ozs. of coconut preserved in 6 ozs. of coconut water sold at 11 cents gold per tin.

Addendum.—The following additional information in respect of marketing of and machinery for desiccated coconut has been received since the above article was written.

A produce merchant in England states that the present price is 40 shillings per cwt. ex-store London or Liverpool, packed in 130 lb. cases. He recommends however that the product be packed in 56 lb. and 100 lbs. cases, with an extra charge of 1 shilling for 56 lb. boxes. He also states that a very large business is done in Manchester at the present time.

Quotations have also been received for another type of dryer—the "Express" Dryer—costing 2,350 francs ex-works, Paris, exclusive of packing.

This dryer has a capacity of about 57 lbs. of shredded coconut and experiments have shown that the moisture content can be reduced from about 41.5 per cent. to 5.5 per cent, in 3-4 hours.

A large continuous dryer of a similar type is also constructed, in which the grated coconut can be delivered from the grating machine on to conveyors in the dryer. No price has been quoted for this type.

The Secretary for Agriculture will be glad to receive enquiries from any firms who are interested in the manufacture of these products and to answer any questions, as far as possible. (Reference D.A. 916/22 should be quoted by enquirers).

CASTOR OIL SEEDS.

NOTES ON OIL CONTENT AND EXTRACTION OF OIL.

By C. D. V. Georgi.

DURING the past year a large number of experiments has been carried out on the determination of the oil content of various varieties of this seed grown locally, and also on the extraction of the oil, and as some useful data have been collected it has been decided to summarise and publish the results.

Seed.

The two common varieties found in this country are the large white bean with brown flecks, usually referred to as the Kedah variety, and the small mottled dark brown seed which is more widely distributed. A medium sized bean with curious light brown markings has also been found but, as this was probably a variety resulting from a cross of the large and small, it calls for no special comment; such a variety would be produced where plants from the large and small seeds were growing side by side.

Storage of Seed.

Unless the seed is being pressed soon after collection care must be taken to ensure that it is kept dry, since, if allowed to become moist, the seed will heat and ferment with a resultant increase in the acidity of the expressed oil.

As an example of this the following case may be quoted:—A large quantity of seed was kept for some months without particular attention being paid to storage conditions, and when the oil was expressed the acidity, calculated as oleic acid was found to be approximately 13 per cent.

Oil Content.

There is little difference between the oil content of the various seeds, when calculated on the whole seed, as the following results, (Table I) taken from recent analyses show, the variation in all cases being within the limits found in the case of natural products.

It may be mentioned that the average yield of about 40 per cent. is somewhat lower than that found in other countries, for example India, where this crop is cultivated. The oil content from the best varieties grown in India is between 45 and 50 per cent.

It is curious to note that the oil content of the two medium sized varieties is the highest.

TABLE I.

	Large variety.		Medium variety.			Small variety.	
	No. 1	No. 2	No. 3	No. 4*	No. 5	No. 6	No. 7
Number of seeds per ounce ...	40	38	45	82	91	215	216
Proportion of Husk, per cent. ...	23.3	21.7	24.9	25.2	25.1	29.7	30.2
Proportion of Kernel, per cent. ...	76.7	78.3	75.1	74.8	74.9	70.3	69.8
ANALYSIS OF WHOLE SEED.							
Moisture, per cent. ...	7.6	7.2	8.6	6.5	7.7	7.6	7.3
Oil Content,† per cent.	41.6	37.3	37.9	44.9	48.3	40.7	36.8
Residue, per cent. ...	50.8	55.5	53.5	48.6	44.0	51.7	55.9
Oil content calculated on dry seed, per cent.	45.0	40.2	41.5	48.0	52.3	44.0	39.7

EXTRACTION OF OIL.

The treatment of castor seed differs from that of other oil seeds owing to the soft non-fibrous nature of the kernels and, although decorticated seed produces oil of paler colour (cold drawn oil from decorticated seed has been obtained practically colourless), this operation is not usually carried out. The soft non-fibrous nature of the kernel renders the satisfactory expression of the oil from decorticated seed difficult, especially if the seeds are fresh ; some fibrous material must be added to act as a binder.

Further the seed is not usually ground before pressing, as the soft kernel makes such an operation difficult and the active enzyme (lipase) which is present also renders rapidity of working desirable. The seed is therefore merely warmed to about 50°C. (120°F) before pressing in order to render the heavy viscous oil more mobile.

On account of the comparatively high viscosity of the oil, even at the increased temperature, it is necessary to employ high pressures to obtain the maximum yield. Frequently seed is pressed twice, once cold, then heated and pressed again. Pressures of between 4,000 to 6,000 lbs. per sq. inch are usually employed, while in America mills are being constructed to work up to pressures of 8,000 lbs. per sq. inch.

*Variety imported from Rhodesia and grown for the first time.

†Extracted with Chloroform.

Castor seed has also been successfully treated in Anderson Oil Expellers (See Agricultural Bulletin Vol. VII, No. 1, January and February 1919) but in this case low pressures must be used as high pressures cause overheating of the oil with discolouration and contamination with meal.

With efficient pressing about 30 to 33 per cent. of oil should be obtained leaving about 10 to 12 per cent. in the cake, which can only be recovered by a solvent extraction process. Such a process would however only be employed where the quantity of castor seed being pressed was sufficient to warrant the installation of the necessary plant.

Castor Oil.

Excluding cold drawn oil, which is used for medicinal purposes and the further treatment of which is a somewhat specialised process, castor oil extracted by either of the methods quoted above is generally suitable for industrial purposes without further treatment. The colour varies from a pale greenish brown to dark brown tint, while the acidity, calculated as oleic acid, is from 2 to 4 per cent. The small amount of albuminous matter in suspension in the oil can if necessary always be separated by blowing steam through the oil. This causes the albuminous matter to coagulate; the precipitate can then be removed either by sedimentation or by passing through a filter press.

Castor Cake.

On account of the presence of the poisonous principle ricin, castor oil cake cannot be used as a feeding stuff, but on account of its high nitrogen content it is a good fertiliser. The average nitrogen content of meal containing between 12 and 15 per cent. of oil averages between 4.2 and 4.8 per cent., which corresponds to between 5.5 and 6.5 per cent. on the dry, oil-free cake.

The presence of excess of oil in the cake besides acting as a diluent also retards its decomposition when applied as a fertiliser, thus lowering its value. The decomposition may not be retarded sufficiently however to affect its value in the case of permanent crops, but with those of short duration the fertilising value would certainly not be so great as with an oil-free cake or one with a low oil content.

OIL EXPELLERS.

By B. J. Eaton.

WITH reference to the previous articles in the Agricultural Bulletin Vol. VII, No. 1, January—February 1919, pages 1—14, and the Malayan Agricultural Journal, Vol, X, No. 5, May 1922, a reduced quotation for the Smulders' Expellers has been received recently and details are given below:—

Heated Distribution Kettle	...	245 Guilders.
Expeller Type B.	...	7,125 „
Spare parts	...	810 „
Interchangeable parts for seeds other than copra	...	1,970 „

The interchangeable parts render the Expellers suitable for the treatment of linseed, cotton seed, mustard seed, kapok seed, ground nuts, and other small seeds and consist of the following parts:—

One Quillworm No. 136.

One threaded spacing collar No. 138 with bronze ring No. 151.

Two discharge worms No. 135.

Two worm spacing collars No. 122.

„ „ „ „ No. 137.

One complete presschamber without clamping bars.

One pulley to drive quill worm No. 237.

The makers state that this Expeller can treat about 440 lbs. of copra per hour; the capacity for other oil seeds is decreased according to the nature of the seed. The Expeller is also used for castor seed but, for this seed, oil presses usually give better yields. (Ref. D. A. 899/22).

WORK OF THE INSPECTION STAFF (April 1st—June 30th, 1922).

By F. W. South.

STAFF.

THE services of all the Special Field Officers in Ulu Selangor were terminated during the Quarter, as it is hoped that Pink Disease in the District has now been got under control so thoroughly as to enable the normal Staff of the Department to maintain such control efficiently and at considerably less expense than was involved in providing three European Officers for this district.

Estate Visits.

One hundred and seventy-nine visits were paid to estates by the Agricultural Inspectors in various parts of the country during the quarter, the majority either as part of routine inspection work, or to advise about treatment of pests or diseases.

Diseases and Pests of Rubber.

Pink Diseases (Corticium Salmonicolor).—This disease was newly reported from eight estates in Selangor, two in Pahang, two in Negri Sembilan and fifteen in Johore.

In Perak North there were bad attacks in Selama sub-district around Selama and Batu Kurau.

In Selangor there was a marked reduction of the prevalence of this disease in Ulu Selangor District owing to the good work of the Special Field Officers in Tanjong Malim and Ulu Yam. The disease continued its spread, reported during the first quarter, westerly and south westerly from the Sungei Buloh forest reserve. This area has received careful attention from the Assistant Agricultural Inspector, Selangor. The outbreak at Batang Berjuntai died out during the quarter.

In Negri Sembilan there were bad attacks in a few areas, the country around Bahau will receive special attention.

In Johore the Inspector of Agricultural found the disease in a number of cases on 10 year old trees of the worst of the badly grown South Johore type. This attack was new to the Inspector and appears somewhat unusual, since the poor foliage on such trees usually allows the entry of sufficient sunlight to prevent infection.

Penang, Malacca and Singapore were free from the disease. In all other centres the position regarding it was as usual and calls for no comment.

Mouldy Rot, (Sphaeronema fimbriatum.)—In Negri Sembilan the rainfall increased in all districts during the quarter and in consequence the disease reappeared in Jelebu district and in the Chuah mukim of Port Dickson district; it became more prevalent, especially on overgrown holdings, in all the other infected areas, and in Kuala Pilah district a few new holdings near Juasseh became infected. Efforts to enforce treatment have been maintained successfully by the Special Field Officers and the Assistant Agricultural Inspector, except in Rembau district where the work has been neglected on account of padi planting.

Painting with disinfectants is now usual, but it is most difficult to stop tapping or to induce owners to change the position of the tapping cut after treatment. A point of interest in regard to many Malay holdings is that they are worked by the Chinese on a profit sharing basis. This practice causes a difficulty in treating Mouldy Rot, as the tappers are not liable in a court action and therefore continue to work the holdings irrespective of the presence of the disease. To overcome this difficulty the Special Field Officer in Seremban district has had personally to supervise the work on most of these holdings.

In Malacca the disease reappeared on the previously infected estate near Alor Gajah on 17th May this reappearance was attended to personally by the Assistant Agricultural Inspector, and the disease has been confined to a very small area by the usual preventive measures.

In Johore Mouldy Rot was newly reported from 5 estates. The disease is spreading. Several properties including two Estates, have been found to contain infected trees at Tampoi, in South Johore. The rate of spread has been rapid on one estate in Northern Johore. There is no rapid spread of this disease in small holdings, but neither is there any diminution in the number infected. The fines imposed by some Magistates act as no deterrent for neglect and make it scarcely worth while bringing cases to Court.

In the opinion of the writer the reason for the frequent reappearance of the disease on previously infected rubber trees even after an interval of 6 or 9 months during which the fungus has been quiescent, requires further investigation to find if possible, a form of treatment that will completely destroy the fungus.

Black Stripe (Phytophthora sp.)—This was newly reported from 1 Estate in Selangor and 1 in Johore. Some very severe cases were found on the estate in Selangor; otherwise Selangor was fairly free from the disease during the quarter, owing to comparatively dry weather.

A few cases were noted on a Chinese owned Estate at Jelebu in Negri Sembilan, but action was taken and the spread of the fungus appears to have been arrested.

Pod Disease.—Two isolated cases of this have been noted by the Assistant Agricultural Inspector, Penang and Province Wellesley.

Root Disease. (*Fome lignosus.*)—The Assistant Agricultural Inspector, Perak North was requested to visit new clearings on one estate where a heavy cover of *Centrosema plumieri* was reputed to be assisting in the spread of the disease. Investigation showed clearly that the cover crop and the debris of decaying vegetation beneath it formed a suitable medium for the growth of the fungus. Other cover crops such as *Tephrosia candida* when planted on young clearings covered with timber also serve to assist the spread of *Fomes lignosus.*

Wet Rot. (*Fomes pseudoferreus*).—The prevalence of this disease on old rubber especially in Negri Sembilan, to which attention was called in my previous report, was well shewn during this quarter when high winds and rain storms prevailed; on many trees that fell the exposed roots showed the characteristic symptoms.

Black Line. (*Ustulina zonata.*)—Fork and branch cases of this disease are reported to be common in North Johore as also are collar cases. In Selangor also fork and branch cases are not rare. The ill effects of delay in removing decaying timber were shown by the number of cases of this disease combined with *Fomes lignosus* and *F. pseudoferreus* on an estate visited by the Chief-Agricultural Inspector in Perak.

Brown Root disease.—This was found to be prevalent combined with *Fomes lignosus* and *Ustulina zonata* on an estate in Northern Johore. Many trees blown over showed all three fungi occasionally with Wet Rot and white ants in addition.

The routine work of enforcing the control of prevalent diseases such as Pink Disease and Mouldy Rot was rendered less effective owing to the fact that the power to authorise court proceedings, originally vested in the Director of Agriculture and automatically cancelled when the appointment was abolished, could not be conferred on the Secretary for Agriculture until special Amendment Bills passed the Legislative and Federal Councils in June.

Coconut Pests and Diseases.

Beetles (*Oryetes rhinoceres*) and (*Rhychophorus Sach*).—The routine work of destroying the breeding grounds of these beetles has been regularly sustained everywhere and good progress has been made in the more seriously infected areas recorded in my report for the last quarter, especially Penang and Province Wellesley, Lower Perak, Kuala Selangor and Klang districts. In Malacca coconut beetles are now only occasionally found, while the Assistant Agricultural Inspector, Selangor, reports that at Port Swettenham a few trees are now bearing fruit for the first time for three or four years. Coconut beetles, probably the black beetle, have been found by the Junior Agricultural Assistant, Ulu Selangor, breeding in the stumps of a jungle palm known to the Malays as Bayas.

Plesispa reichii.—Numerous young palms on a holding near Rasa station in Ulu Selangor were found to be attacked by this beetle.

The Assistant Agricultural Inspector, Negri Sembilan, records the presence of Aphis, scale insects and skipper caterpillars on certain coconut palms, but none of the insects were doing serious damage.

Padi Pests and Diseases.

Stem Borers.—These insects (species not given) did some damage in two localities in Selangor where the owners neglected to burn the old stubble after harvesting. Otherwise the padi in Selangor is so far comparatively free from pests.

Army worms (Species not specified.) A few isolated cases of attacks of what were probably these insects are recorded on nursery beds in the Kuala Pilah and Rembau districts of Negri Sembilan.

Rats.—These did considerable damage in one area in Kuantan district. The area is comparatively large, but only a portion was being cultivated, with the result that it was difficult to find and destroy the breeding places of the rats in the undergrowth surrounding the padi. Traps gave the best results in destroying the animals.

The Department has distributed to outstations a supply of barium carbonate which is a cheap and effective poison for rats. Its use is being explained to planters of padi and the District Officers in several districts have been supplied with an account of the methods of preparing poisoned baits.

No other reports of pests have been received as in many parts of the country padi planting has not yet commenced.

Lalang and Blukar.

There is little to report under this heading. The general policy as regards infested holdings remains unchanged, since owners of rubber land cannot afford to clear their land in most cases. The expected results are now becoming evident generally and lalang is very prevalent all over the country.

Water Hyacinth.

The gang of coolies in Perak North worked in various parts of Krian until the beginning of June. After this they worked for twelve days around Taiping and on June 19th proceeded to the Perak River and were at work near Parit at the end of the quarter.

In Perak South four coolies are working in a small tributary of the Perak River—the Sungei Sireh, as the weed was plentiful there and caused obstruction to estate drains.

In Pahang East a patch of Water Hyacinth on State land near Kuantan is to be removed.

Owners have been required to remove this pest from their land around Taiping; in small areas in Selangor; and in remote places in Negri Sembilan.

It will be seen that in the Federated Malay States work is being continued steadily. In the Colony the drains are cleared periodically of scattered patches of the weed by the Public Works Department, but no other action is taken, as little if any harm is done. In Johore the destruction of Water Hyacinth is in the hands of the Assistant Advisers and District Officers.

Pests and Disease of other Crops.

Pests of Roselle.—Mealy bugs did some damage to roselle on an estate in Perak South. Cotton Stainers (*Dysdercus sp.*) are recorded to have attacked it near Kuantan but to have been controlled by a nicotine spray. These strainers are also recorded on cotton in Negri Sembilan. They are present on plants of the genus Hibiscus all over the Peninsula and are becoming commoner. Scale insects including *Lecanium nigrum* are recorded on Roselle and Hibiscus plants in Malacca and aphids have been found causing a leaf curl on Roselle in Malacca; emulsions were used successfully to check the scale insects.

Pests of Citrus.—White fly and an unidentified beetle were found on citrus in Pahang East. Scale and aphis are recorded from Negri Sembilan. Scale insects and a large brown bug were found commonly on young citrus plants in Malacca. An internal caterpillar was found in pomelos in Negri Sembilan and is common in this fruit generally; it is under investigation by the Entmologist.

Banana Skippers (Erionoto Thrax).—These were common in Selangor and Nergi Sembilan, but did little damage.

Miscellaneous Pests.—Grasshoppers have been prevalent on various hosts in Negri Sembilan and scale insects and aphis have been found on various fruit trees. Specimens of many of these pests have been forwarded to the Government Entomologist who has supplied reports on them, and when necessary, taken steps to have them identified. Special attention is being given to pests and disease of general crops in order to ascertain which may prove serious if any crop is cultivated on a large scale.

Die back of Durians is recorded from a locality near Batu Gajah.

Stem Disease of Rambutans.—An interesting fungus disease on the bark of the stems and main branches of Rambutans and probably also of Pulasans was noticed in some old dusuns of the Lubok Salak path near Tanjong Malim. The fungus always associated with the disease forms large fruiting bodies at first yellow then brown on the surface of the infected parts. It appears to be an Ascomycete.

Pink Disease has occurred on Fruit trees and other cultivated plants and shrubs in Ulu Selangor all such alternative hosts are being carefully recorded.